

OPS Workshop on Pipeline Safety

Research & Development

Existing and Future Research -

Technologies to Ensure the Safety, Integrity and Reliability of the U.S. Pipeline System

November 27, 2001

Outline

- ***Transmission Pipeline Market Environment***
 - ***Operational Priorities***
 - ***Technology Needs***
 - ***Pipeline R&D***

Transmission Pipeline Market Environment

- **Growing Demand; electric/distributed generation, residential/commercial/industrial growth; 24 Bcf/day new gas capacity (supply and transport) needed to meet projected 30 Tcf 2015 demand; growing role of conservation and energy efficiency**
- **Growing uncertainty and criticality of supplies of electricity; growing criticality of gas in generating electricity; *expensive gas – expensive electricity, no gas – no electricity?***
- **Existing infrastructure is aging; congested right-of-way; continued industry consolidation, company technology and support groups responsible for greater mileage & more throughput, the need to do more with less**

Chicago Tribune April 9, 2001

Surge is seen in gas-fired power plants

By Jeff Long and Melita Marie Garza
Tribune staff reporters

Plans are on the drawing board for dozens of new gas-fired power plants in Illinois, reflecting a national trend that will put even more demand on a supply that this year, at least, was so low that prices soared.

No one expects the natural gas supply to remain that low for long—hundreds of new wells are being drilled because of higher prices—but the boom in the gas-fired generation of electricity raises questions about whether high demand from those plants will prevent prices from sliding back to what they were a few years ago.

And as electricity becomes increasingly tied to natural gas, observers say the demands on one are more likely to change the price of the other.

"We should be concerned about it," said William Abolt, Chicago's environment commissioner. "You're getting one energy market where the decisions that are made about natural gas affect the price of electricity."

Although Abolt advocates using natural gas instead of coal to generate electricity—"It means cleaner air," he said—he wonders if the gas industry is prepared for growing demand on its supplies.

Generating electricity takes a lot of gas. Midwest Generation's gas-fired power plant in Morris last year burned

Producing power
Illinois has the capacity to generate 34,000 megawatts of electricity from three sources.

Source	Percentage
Coal-fired plants	50%
Nuclear reactors	30%
Natural gas-fired plants*	20%

*Most gas-fired plants, or "peaker plants," are used only during high demand.

A RISING GAS TREND
The portion of electricity made from natural gas-fired plants is growing. The Illinois EPA is considering or has approved proposals to build plants that would generate an additional 21,700 megawatts.

ILLINOIS EPA STATUS	MEGAWATTS
Notice to build filed	1,100
In review process	7,900
Permits issued	7,600
Under construction	5,100

Note: A megawatt is 1 million watts—enough power for about 400 homes. It takes about 10,000 cubic feet of natural gas to generate a megawatt for an hour.

Source: Illinois Environmental Protection Agency

enough to keep about 192,000 homes supplied with natural gas for a year: 24 billion cubic feet. That plant generated only

PLEASE SEE POWER, PAGE 4

Gas Transmission Pipeline Sectors

- **Transmission defined as >20% SMYS was reported @ 325,000 miles**
 - **INGAA Members 210,000 miles**
 - Larger diameters, mostly rural
 - **AGA Members 45,000 miles**
 - Smaller diameters, more urban
 - **Municipals > 45,000 miles**
 - Smaller diameters, mainly urban



Pipeline & Gas Journal

Oil Pipeline Sector

- **Approximately 200,000 miles of oil pipelines**
 - **Crude trunk and gathering lines - 114,000 miles**
 - **Product trunk lines - 86,000 miles**

- **Percent of all crude oil and refined products transported carried by pipelines - 66.6%**



Transmission Pipeline Market Environment (cont'd)

- Excellent safety record; very few but high visibility incidents; Edison, Bellingham, Carlsbad
- Difficulty in siting new pipelines; regulatory and permitting burden; NIMBY, BANANA



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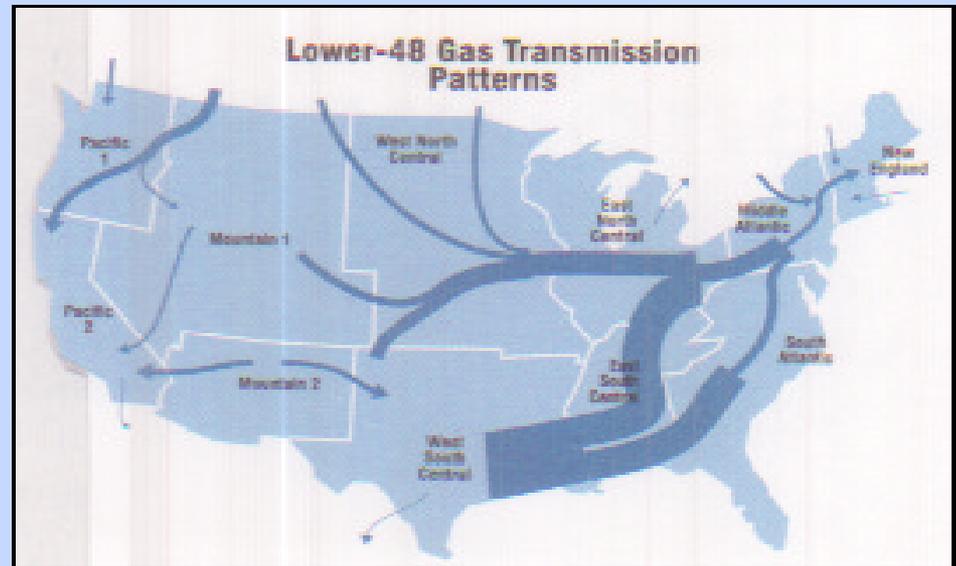
'ROLLING WALL OF FIRE'

ANTHONY A. GALLOTTO, JONATHAN JAFFE and TOM HAYDON

EDISON BLAST BRINGS MASSIVE DESTRUCTION, LEAVES 1 DEAD

Transmission Pipeline Market Environment (cont'd)

- Increasing Federal and State pressure; regulatory oversight expanding.
 - USAs & HCAs, soon Integrity Management
 - Growth in funding and involvement in R&D – DOE/NETL & DOT/OPS, state R&D funding initiatives.
- Gas price volatility?; supply and demand imbalances
 - Growth Predicted
 - Path Uncertain

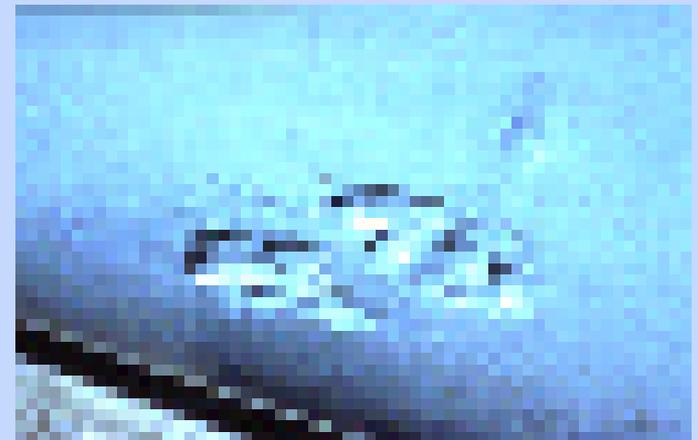


Operational Priorities

- **Safety**
To operating personnel and the general public
- **Integrity**
Maintenance of a sound, unimpaired pipeline system that meets all relevant codes and standards
- **Reliability**
Operation of the pipeline system and delivery of natural gas and liquid fuels as the systems were designed, with confidence and dependability
- **Deliverability**
Delivery of natural gas and liquid fuels to customers in the quantities and at the time needed

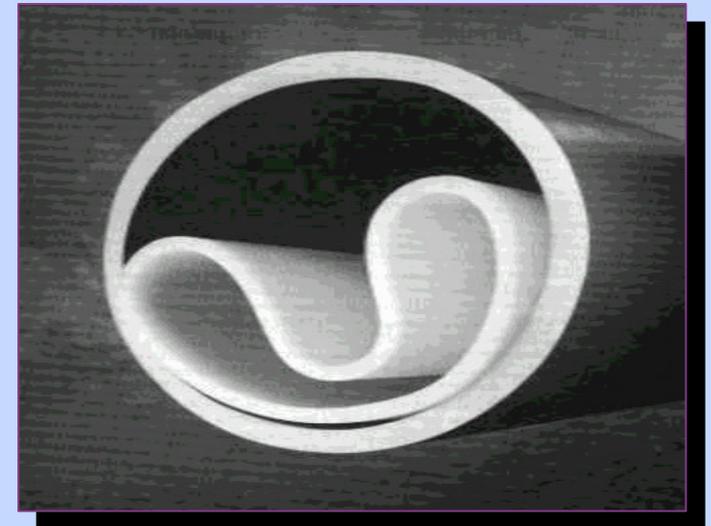
Technology Needs

- **NDE Technology & Services**
 - **Locate major and minor defects; prior mechanical damage, corrosion and metal loss, SCC (axial cracking), coating disbondment**
 - **Inspection technology testing and evaluation; detection, quantification, & discrimination,**
- **Pipeline Right-of-Way Management**
 - **Pipeline encroachment detection**
 - **Real-time third party damage detection**



Technology Needs

- **Pipeline Corrosion Control**
 - External, internal and & MIC (microbially-induced corrosion); detection, mitigation, prevention
 - Improved Coating Reliability and Compatibility; easier to apply, last longer, less costly
 - Managing Stress Corrosion Cracking



Technology Needs

- **New Pipeline Materials**
 - **Stronger, Tougher, More Damage and Defect Resistant Pipe**
 - X80 & X100 Steels
 - Fracture Initiation and Control
- **Safe Operation of Early Pipelines**
 - 50% of Existing Gas Pipelines Over 50 Years Old
- **Management and Repair of In-service Damage**
 - Keeping Lines Safely in Service to Assure Deliverability
- **Safer Construction & Maintenance Welding**



Technology Needs

- **Managing External Loads**
 - Onshore & Offshore Land Movements
 - Excessive Surcharge and Wheel Loads
- **Designs for Safe Arctic Construction; ANGTS, Over-The-Top Proposals**
- **Managing Information Requirements for Risk Assessment**



Pipeline & Gas Journal

Pipeline R&D

■ NDE Technology & Services

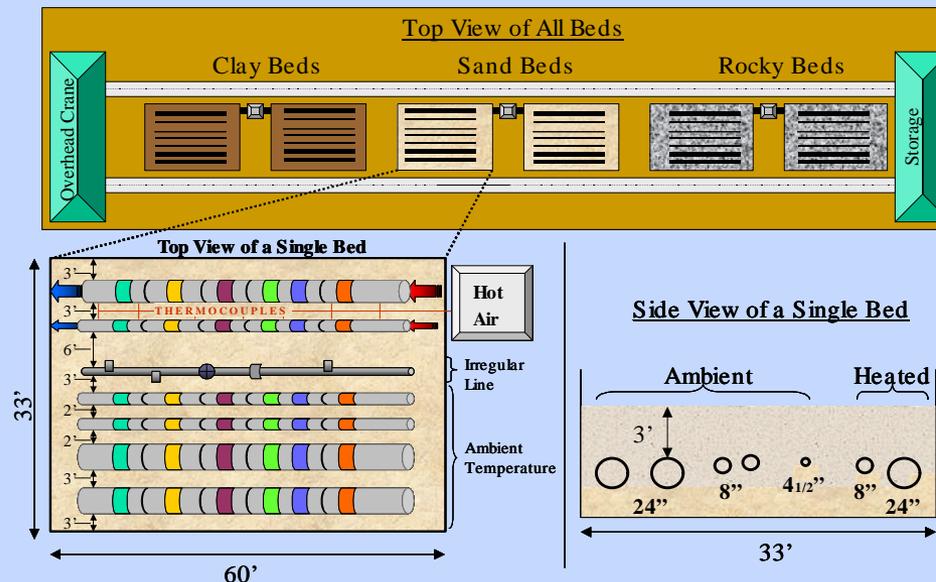
- Develop advanced ILI (in-line inspection) sensors and data interpretation; magnetic flux leakage (MFL), ultrasonic (such as EMATS – electromagnetic acoustic transducer), remote field eddy current, gas coupled ultrasonic. Locate and characterize mechanical damage, corrosion, SCC, coating disbondment.
- ILI sensors and delivery vehicles for unpiggable lines (future).
- ILI pig testing and certification facility; evaluate in-pipe performance of sensors and data interpretation.



Pipeline R&D (cont'd)

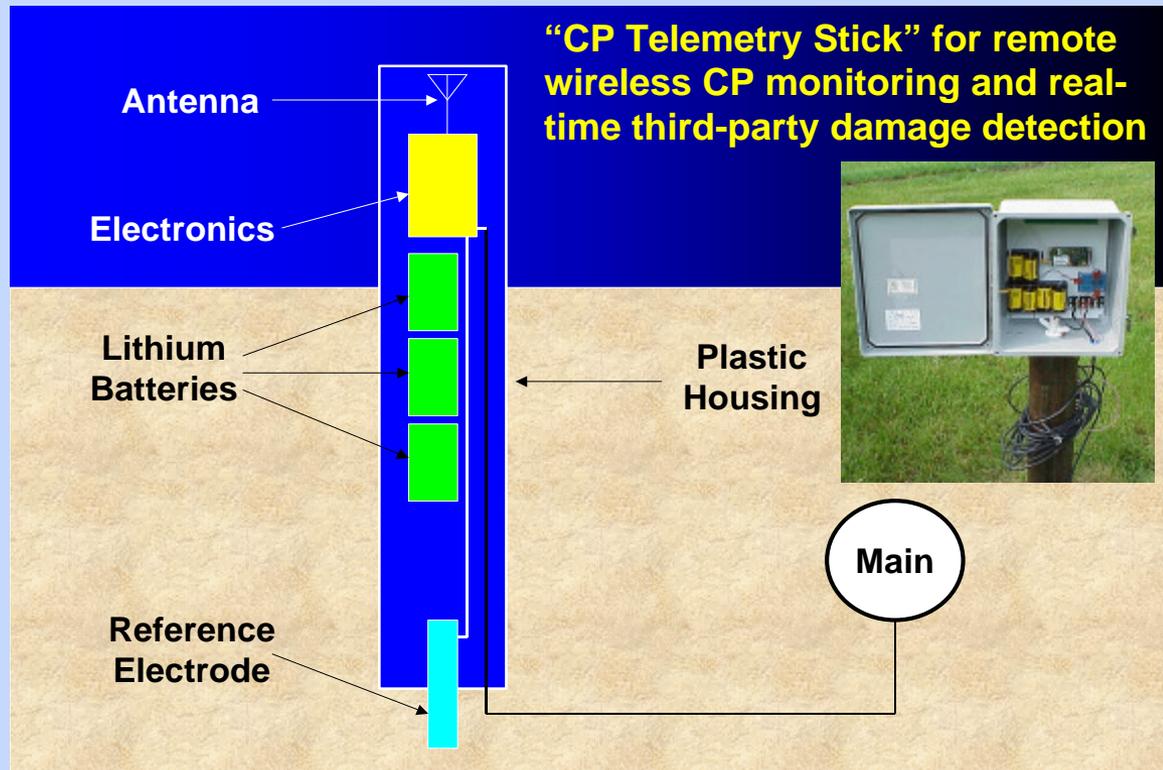
■ Advanced Corrosion Control

- Develop high performing, cost-effective field applied pipeline coatings
- Testing and certification of commercially available pipeline coating systems, in-ground on full-size line pipe (future)
- Jobsite training for the proper application of field applied coatings (future)



Pipeline R&D (cont'd)

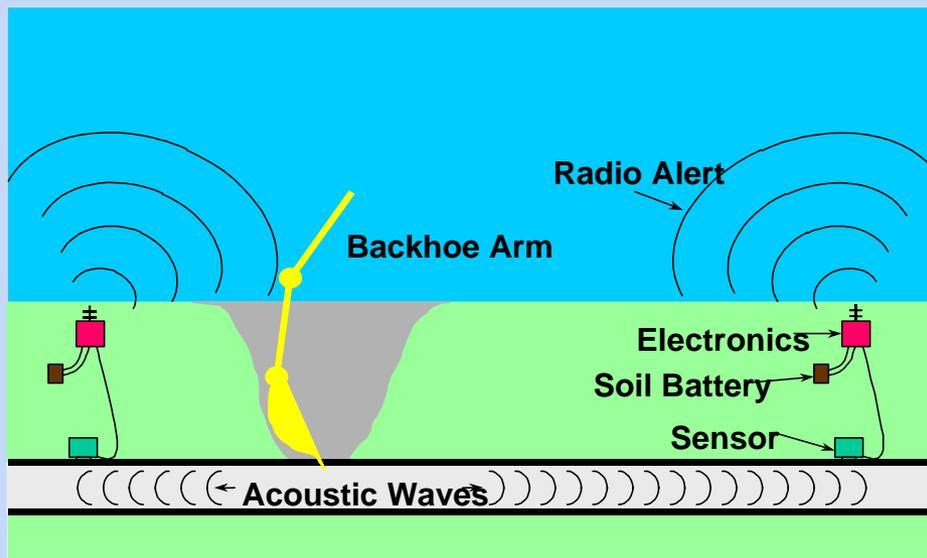
- **Advanced Corrosion Control (cont'd)**
 - Systems that ensure that proper cathodic protection is being maintained and determine the effectiveness of CP systems; remote wireless monitoring of impressed current CP performance



- Systems to detect MIC and determine optimum control options and procedures; environmentally benign MIC inhibitors

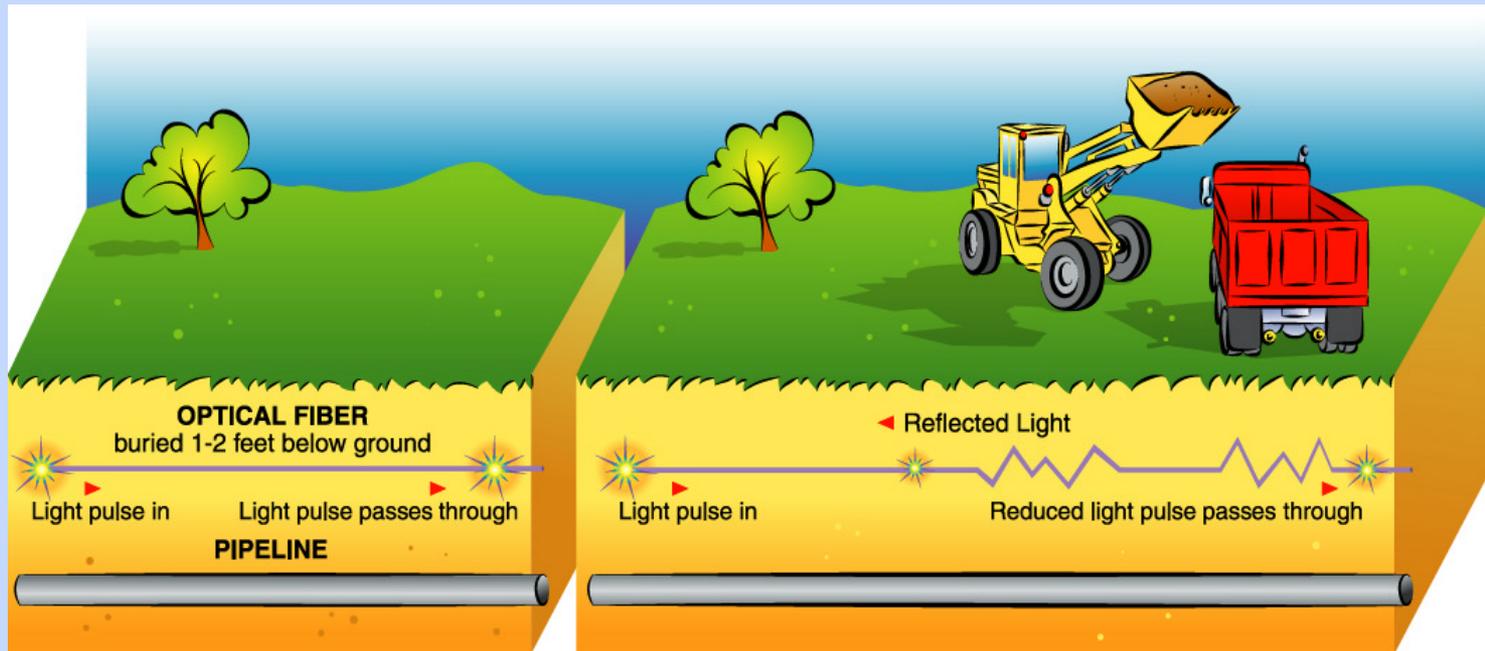
Pipeline R&D Plan (cont'd)

- Pipeline Right-of-Way Management
 - Real-time monitoring and alert of third-party damage to buried pipelines; acoustic sensing of hard contact, cathodic protection current “spikes”



Pipeline R&D (cont'd)

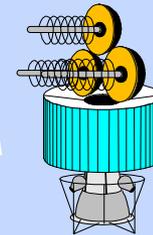
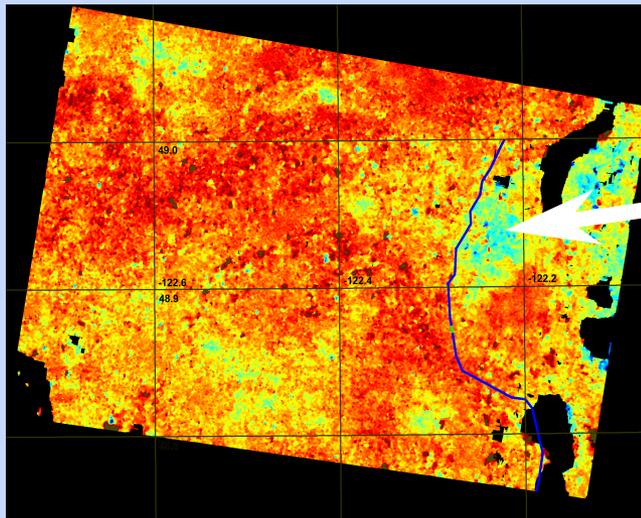
- **Pipeline Right-of-Way Management (cont'd)**
 - **Systems to detect encroachment of digging equipment before contact is made with buried pipe.**



Buried optical fiber system detects and warns of the presence of heavy equipment in pipeline R-O-W.

Pipeline R&D (cont'd)

- **Pipeline Right-of-Way Management (cont'd)**
 - Education and communication in support of effective one-call systems; Common Ground Alliance



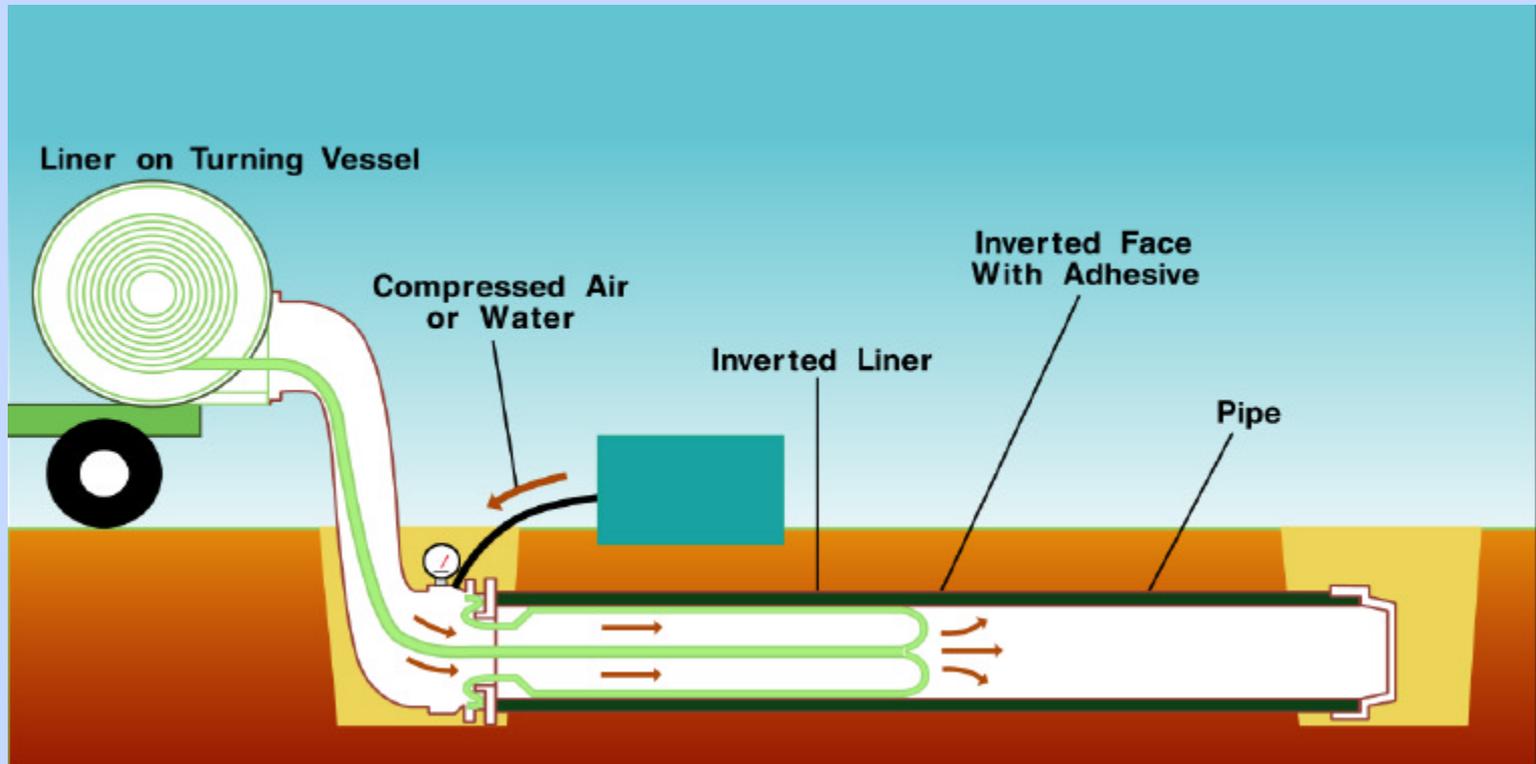
3.5" over 6 months

Deformation Map, Everson, WA

- **Subsidence & Movement by Satellite (future)**
- **Remote Detection of RoW Encroachment (future)**

Pipeline R&D (cont'd)

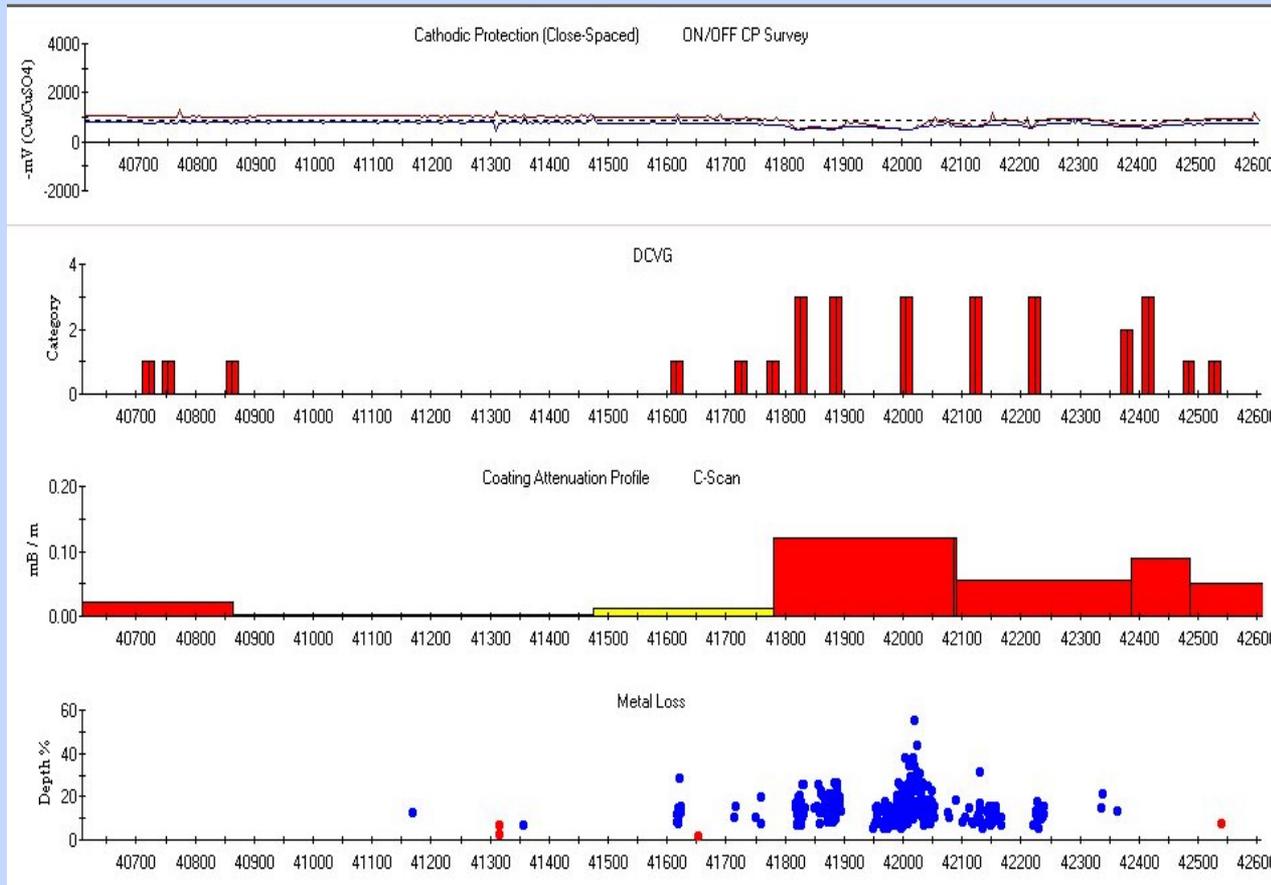
■ High Pressure Pipe Liner



The HPL will be made for a full range of gas pipeline diameters and pressures to 1000 psi. Depending on the diameter, the HPL will install in 1500 ft of pipe with a single inversion.

Pipeline R&D (cont'd)

- External/Internal Corrosion Direct Assessment Validation



CIS

DCVG

Coating

MFL-ILI

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